Assessment of Smallholder Urban and Peri-Urban Dairy Production with Zero-Grazing Practices in Kampala, Uganda

Honors Research Thesis

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ABSTRACT

Many people in Kampala, the capital city of Uganda, own a few dairy cows to provide milk and income for their family. Most of these dairy farmers feed their cows with a system called zero-grazing, where the cows are confined and feed is carried to the cows. This research project evaluated the smallholder dairy system in urban and peri-urban Kampala, Uganda. Several research studies have previously been conducted on specific parts of smallholder, non-grazing dairy farms in Africa. However, this project was unique in the fact that it focused on the urban, smallholder dairy farming system as a whole. The main objectives of this research project were to 1) collect information from 10 urban and peri-urban dairy farmers that could be used to better understand their production systems and 2) identify how farms might be improved to benefit the farmers and their families. Ten farms that use zero-grazing practices to were surveyed. Each survey included five parts: Feed analysis, cow evaluation, milk yields, milk marketing, and miscellaneous. It was found that many of the farmers struggle with the same challenges, which include feed scarcity, herdsmen, vet, and inseminator unreliability, and lack of capital. The dairy cows in Kampala are not getting enough feed, which results in low milk production levels and reduced fertility. Each family interviewed recognized the nutritional importance of the milk they collected and consumed. Where there is lack of good dairy herd management knowledge, education can help. However, the bigger problem for these smallholder farmers is the lack of support and capital to put into practice beneficial management procedures for their cows. This project provided much needed holistic information on the smallholder, urban dairy system in Kampala and showed the small amount of education and empowerment needed to make these farmers more productive and resilient.

INTRODUCTION

Urban farming and smallholder dairy farms are essential in Kampala, Uganda (see Appendix 2 for a picture of Kampala). Urban and peri-urban dairy production in Kampala provides a source of income for those of low socio-economic status, utilizes organic waste products from the city that would otherwise go unused, and allows women, some of whom are unmarried or widows, to sustainably provide for themselves and/or their families (Sabiiti et al., 2014). Milk is extremely important for food security in Uganda because of its nutritional quality and its year-round production (Kabirizi et al., 2014). Since the majority of milk consumed comes from cows (rather than goats or other species), cows are also extremely important for food security in Uganda. People living in Kampala, especially the low-income families, are faced with many unpredictable circumstances, but having their own small farm helps them to become more resilient and buffered against short-term change (Sabiiti et al., 2014). Smallholder urban and peri-urban farms in Kampala form a large component of the informal market, as most farmers in Kampala choose to sell their products to their neighbors or through other avenues that are not part of the traditional commercial dairy industry (Sabiiti et al., 2014). The informal market is a vital component of food security in Kampala as it provides nutritional sources that are local and fairly inexpensive (Sabiiti et al., 2014). If the smallholder farmers' production increased, more would be available to the informal market. Dr. Sabiiti believes that the city of Kampala needs to put more emphasis on supporting the informal market (Sabiiti et al., 2014).

Kampala is both the capital and largest city of Uganda (Sabiiti et al., 2014). Kampala contributes 25% to the national economy (Sabiiti et al., 2014). It may seem redundant to develop and study urban and peri-urban dairy systems in Kampala when there is a thriving dairy industry in the rural areas of Uganda. However, milk is unique in the fact that it requires cold storage in

order to not spoil and Kampala has a shortage of refrigerated dairy suppliers throughout the city (Sabiiti et al., 2014). Uganda also does not have a reliable transportation system for agricultural products (Sabiiti et al., 2014). Milk needs to be produced in the vicinity of where it will be sold and consumed. It is not an option to have no milk in the urban and peri-urban areas, since milk contributes greatly needed nutrients to the people of Kampala (Kabirizi et al., 2014). Milk has also been shown to have a positive affect on Body Mass Index in Uganda and it makes the immune system stronger (Kabirizi et al., 2014). Therefore, the production of milk in the urban and peri-urban areas of Kampala and the factors that influence milk production are crucial to the health of the people in Kampala.

Zero-grazing systems for dairy production have become quite common in Kampala because of decreasing space (Sabiiti et al., 2014). However, there is poor documentation of these production systems, which led to the first objective of this study. Since approximately 52.5% of livestock farmers in Kampala use a zero-grazing system, there is a large need for feed (Sabiiti et al., 2014). The poor of the city sometimes fill this need when they collect organic waste or other types of feed and sell it to the farmers (Sabiiti et al., 2014). Therefore, supporting and helping the smallholder farmers of Kampala helps others in the city who are indirectly connected to the urban farming The need for more food in Kampala is only going to increase as time goes on because Kampala is growing and expanding very quickly (Sabiiti et al., 2014). Surprisingly, females make up the majority of urban and peri-urban famers in Kampala (Sabiiti et al., 2014). Small-scale dairy farming provides a way that women, including those who are widowed and as a result have fewer opportunities, can supply a reliable source of food and income for their families. This research project aimed to go beyond simply gathering information from different

dairy farms and sought to contribute to the process of helping to improve the nutritional and income security of the people of Kampala.

The amount of milk that Ugandan cows produce is directly influenced by the nutrition they receive, their health status, their age, etc. Several studies that explore the health of dairy cows and the processing of milk have been conducted in sub-Saharan Africa. One study took place in Cameroon and focused on peri-urban dairy production (Kameni et al., 1999). However, this research study only covered a few basic aspects of the dairy production process and concentrated on the processing of the milk (Kameni et al., 1999). Even though this study included milk yield, it did not address dairy nutrition and did not examine zero-grazing farm systems (Kameni et al., 1999). Another dairy study, which took place in Tanzania, was conducted on zero-grazed farms, but this study mainly examined genital infections in bulls and the effect of these on fertility (Swai et al., 2005). A third study examined the occurrence of subclinical mastitis in approximately the same population and area that this Ugandan smallholder dairy project was conducted in (Abrahmsen et al., 2014). Focusing primarily on a specific aspect of the cow's health, this study also recorded information on the grazing system, breed of the cows, milk production numbers, etc., but it did not explore the marketing of the milk or the nutrition details (Abrahmsen et al., 2014). Therefore, the study did not cover the entire urban and peri-urban dairy system.

All of these previous studies examined certain dimensions of the African dairy system. This particular study was unique and focused on general information in order to give a big-picture view of dairy production in Kampala. The overall objective of this study was to complete a survey on 10 smallholder dairy farms in urban and peri-urban Kampala in order to provide a more thorough understanding of the dairy system as a whole and how it could be improved to

better the farmers' lives. The whole smallholder dairy system in the urban and peri-urban areas of Kampala, Uganda was evaluated, including the types and amount of feed that the cows were receiving daily, the breed, age, reproduction method, body condition score (BCS), and health status of the cows, the average daily milk yield in early and late lactation, the marketing details of the milk, and the challenges the farmers were facing. We hypothesize that the cows will not have adequate nutrition, resulting in suboptimal milk yield, and the farmers will be dealing with many challenges. This research study has the potential to not only impact the smallholder dairy farmers and their families, but also many other people in urban and peri-urban Kampala. The information collected during this project has been given to Dr. Sabiiti and Makerere University, so they are now able to put it to use in the country of Uganda.

MATERIALS AND METHODS

This study was conducted using a survey format and most of the data collected was qualitative. The survey used in this project included five overall components (Appendix 1).

The first survey section focused on the feed. The farmers were asked about the type of feed they gave to their cows, where they got their feed, the feed cost, the daily feeding schedule, if any supplements were used, etc. The feed present at the time of the interview was weighed using a bathroom scale. Each herdsman stepped onto the scale to get a baseline weight. The herdsmen then gathered an armful of feed and stepped onto the scale again. The weight of each armful of feed was recorded and the herdsman's weight was subtracted from the total weight of each armful. The resulting weights were then added together to get an approximate weight of feed given to each cow per day.

The second section of the survey focused on the cows and the herd. The information gathered in this section included cow breed, body condition score, cow age, breeding information, health issues, manure scoring, etc. The body condition score of each cow was determined through observation. A weigh tape was used around the circumference of each cow right behind the front legs in order to obtain an estimated girth size and weight. Manure scoring was based on a 1 – 5 scale, with 1 being completely liquid and 5 being a very firm pile of distinct manure balls stacked up tall.

The third section of the survey covered the average milk output per cow per day. Information on milking times and hygiene practices was also recorded. If the farmer had at least one cow milking during the time of the interviews, they were given a small bottle to collect a milk sample for milk fat analysis. The bottle was given to the farmers on the first farm visit and was collected at the second farm visit. Each farmer was given instructions to collect the sample from the middle of the milking bucket, instead of collecting the first milk out of the teats, in order to ensure an accurate reading. After the samples were collected, they were refrigerated at Makerere University. Faculty members at the university then analyzed the samples for milk fat content using the Gerber Method.

The fourth section of the survey covered the marketing aspect of the milk. The farmers were asked how much milk they keep for their families and how much they sell, who they sell their milk to, how much they sell their milk for, how important the milk is to their families in terms of nutrition, etc.

The final miscellaneous section covered the space available per cow, challenges the farmers face, what they do with the manure, and if they keep any records. A measuring tape was

used to measure the width and length of the structure for the cows. The total space was divided by the number of cows in order to find the space available per cow.

Ten different urban or peri-urban farms in Kampala, Uganda were visited twice from June 7 – June 23, 2017. The first visit included introductions and asking if the farmers were willing to participate in the research study. The second visit was when the actual interview and measurements took place. Most of the information in this study came directly from the farmers, as they know their cows the best. In order to ensure ease of communication and understanding, a senior lecturer and faculty member from Makerere University in the Department of Animal Production, Dr. Constantine Katongole, came on all of the farm visits. Dr. Katongole had an existing relationship with most of the farmers used in this study, which helped build the farmer's trust in the research study. Most of the interviews took place in Luganda, the local language of the central region of Uganda, and Dr. Katongole translated into English.

This research project was submitted to The Ohio State University Office of Responsible Research Practices for IRB review. After review, it was determined that this project was IRB exempt. SAS software was used to obtain simple statistical data on the research information. P-values were generated in order to see if any of the data was correlated or significantly related. Any p-value below 0.05 was deemed significant. Any p-value greater than 0.05 but less than 0.10 was deemed a trend. This research project was presented at The Ohio State University and sent to Dr. Sabiiti at Makerere University in the spring of 2018.

RESULTS

Each farmer expressed challenges that they faced specifically as smallholder dairy farmers in an urban environment (see Figure 1). The most frequent challenge mentioned was feed scarcity. Many of the dairy farmers obtained their grasses for feed from open, public lands

in Kampala. Those lands are quickly disappearing as the city continues to expand, creating a feed shortage. Feed scarcity was also more of an issue during the dry season compared to the rainy season. These farmers were interviewed in the middle of June, meaning they were just coming out of the rainy season and starting into the dry season. There had been a drought in Kampala the year before. Most of the cows were not getting enough to eat. The amount of feed on a wet matter basis was around 11 – 54 kg/cow/day (2 – 11 kg/cow/day assuming 20% dry matter content). Inadequate nutrition has a large impact on body condition scores, reproduction, and milk production.

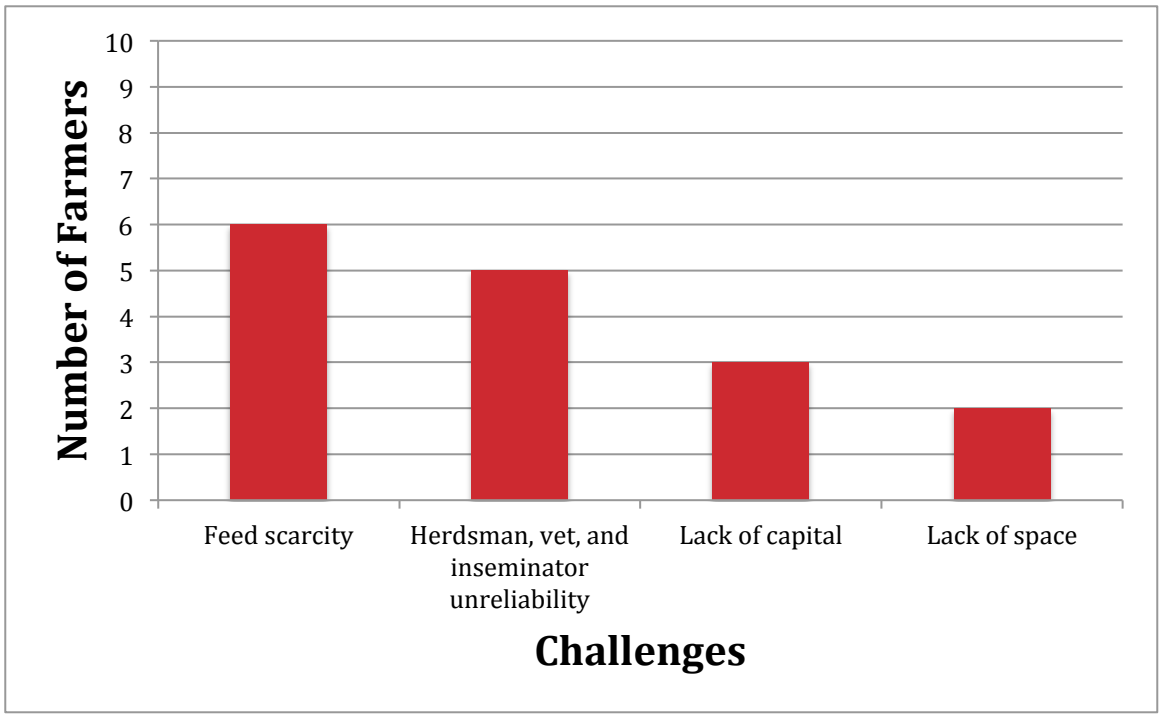

Figure 1: Farmer Challenges

Half of farmers (5 out of 10) also had challenges with herdsman, vet, and inseminator unreliability. Finding quality employees and experts can be difficult for these smallholder farmers. Most farmers (8 out of 10) hired a herdsman to do the feed collection and distribution as well as the daily milking. However, sometimes these herdsmen do not follow the exact schedule

or directions that the farmers give them, meaning the farm does not always get managed the way the farmers want it to.

See Table 1 below for a basic summary of some of the information that was collected in the interview sessions with the 10 farmers.

	Feed amount per day	Breed	BCS	Weight	Breeding Type	Milk Fat
John's Farm						
Cow #1	50 kilograms	75% Friesian	4	578 kilograms	AI	N/A
Cow #2	50 kilograms	75% Friesian	3	378 kilograms	AI	N/A
Betty's Farm						
Cow #1	18 kilograms	75% Friesian	2	426 kilograms	AI	3.88%
Cow #2	18 kilograms	75% Friesian	2.5	432 kilograms	AI	3.88%
Theresa's Farm						
Cow #1	54 kilograms	Exotic and local cross	2	384 kilograms	NS	3.58%
Harriet's Farm						
Cow #1	43 kilograms	Exotic and local cross	3.5	247 kilograms	AI	N/A
Cow #2	43 kilograms	Exotic and local cross	3	426 kilograms	AI	N/A
Cow #3	43 kilograms	Exotic and local cross	3.5	280 kilograms	AI	N/A
Cow #4	43 kilograms	Exotic and local cross	3	225 kilograms	AI	N/A
Rose's Farm						
Cow #1	48 kilograms	Exotic and local cross	4	587 kilograms	AI	4.00%
Cow #2	48 kilograms	Exotic and local cross	3	340 kilograms	AI	4.00%
Foster's Farm						
Cow #1	11 kilograms	Pure Friesian (exotic)	2.5	487 kilograms	AI	3.12%
Cow #2	11 kilograms	Exotic and local cross	3	330 kilograms	AI	3.12%
Godfrey's Farm						

Cow #1	11 kilograms	80% Friesian	3.5	384 kilograms	NS	N/A
Deborah's Farm						
Cow #1	54 kilograms	75% Friesian	4.5	390 kilograms	AI	N/A
Cow #2	54 kilograms	75% Friesian	4.5	280 kilograms	AI	N/A
Florence's Farm						
Cow #1	54 kilograms	Pure Friesian (exotic)	4.5	750 kilograms	AI	3.10%
Jennifer/Wilson's Farm						
Cow #1	N/A	80-85% Friesian	2.5	447 kilograms	NS	3.30%
Cow #2	N/A	80-85% Friesian	2	426 kilograms	NS	3.30%
Cow #3	N/A	80-85% Friesian	2	303 kilograms	NS	3.30%
Cow #4	N/A	80-85% Friesian	3	330 kilograms	NS	3.30%
Cow #5	N/A	80-85% Friesian	3.5	426 kilograms	NS	3.30%

Table 1: A Sample of the Interview Data Collected

Every farmer that was interviewed fed their cows grasses and banana peels (see Figure 2). Maize stover was also a very popular feed source. In terms of supplements, 8 out of 10 farmers provided a mineral block for their cows. Half of the farmers (5 out of 10) gave their cows brewer's waste, an expensive byproduct from local alcohol factories (see Appendix 2 for feed pictures). The weight of grass given to a cow each day was found to be significantly correlated to Body Condition Score ($p = 0.0403$). As the weight of grass fed per day increased, the Body Condition Score increased (see Figure 3). As the Body Condition Score increased, milk production in late lactation tended to increase ($p = 0.0501$). Therefore, milk production in late lactation tended to increase with a greater weight of grass given daily to each cow ($p = 0.0633$).

An increase in body weight tended to result in an increase in early lactation milk production (p = 0.0735).

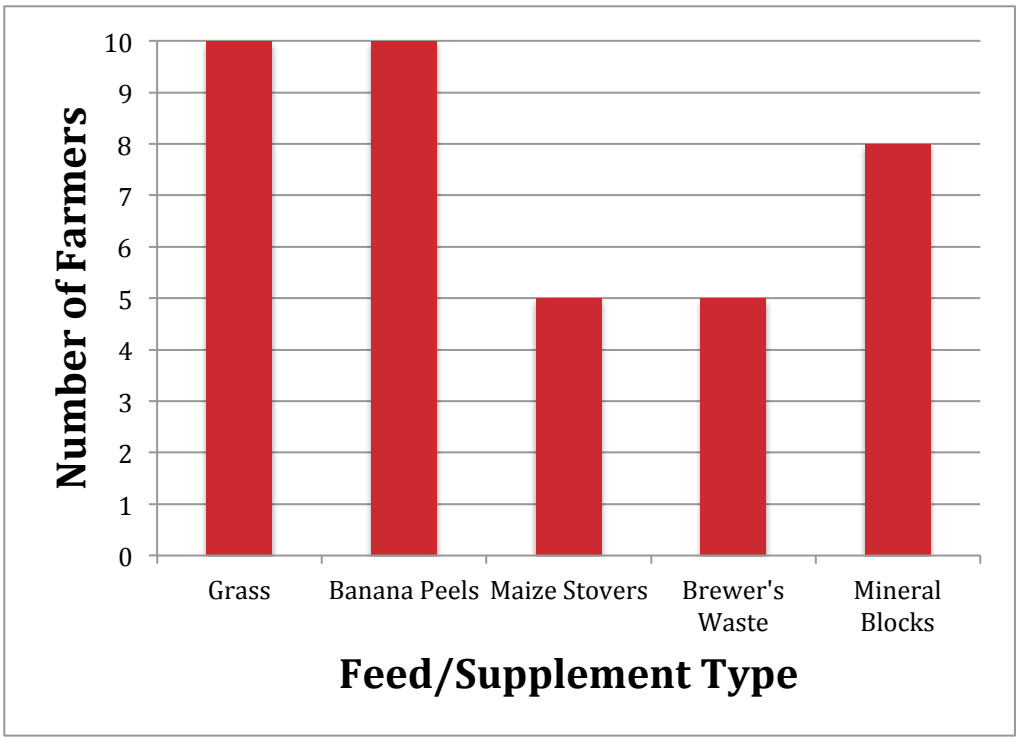

Figure 2: Feed/Supplement Type Used

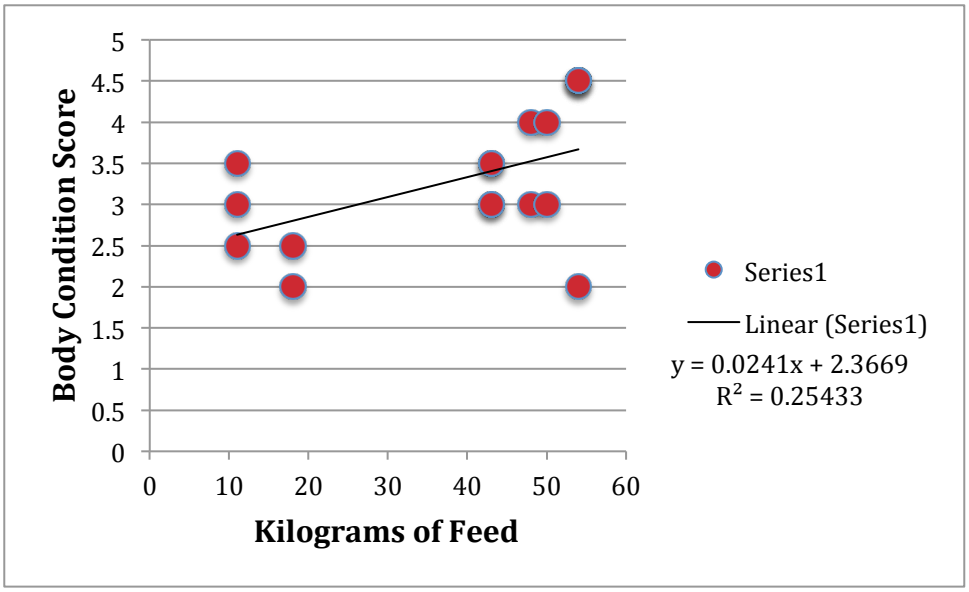

Figure 3: Trend Between Kg of Feed Given and BCS

Artificial insemination (AI) was the most popular method of breeding for the 10 farmers interviewed, as 7 out of the 10 farmers used AI. However, the artificial insemination was usually not successful on the 1st service and the farmers had to keep paying for the AI until it was successful. In contrast, the other 3 farmers used natural service (NS) with a bull to breed their cows. The natural service was always successful on the 1st attempt. 2 out of the 7 farmers using AI were using synchronizing hormones in conjunction with the AI. The synchronizing hormones made the AI so much more successful.

Most of the cows in this study were Friesian (exotic) and local crosses (see Appendix 2 for pictures). The crossed cows worked, but they were average performers in terms of milk production. The pure and higher percentage Friesian cows produced 22 more liters of milk per day on average compared to the crossed cows. Therefore, Friesian genetics were linked to high milk production. There was a highly significant correlation between breed and early and late lactation milk production, meaning that pure Friesians produce much more milk ($p < 0.0001$ early lactation, $p = 0.0060$ late lactation).

DISCUSSION

If these smallholder dairy farmers are going to continue to manage cows and produce milk in the urban area of Kampala, they need to find a consistent and sustainable feed source. Grasses from open/public lands are becoming less available. Therefore, the farmers need to find a replacement for the grass or possibly grow some themselves if they have the space. Feed sources for these cows need to be inexpensive and consistently available. Using waste products such as banana peels, maize stovers, brewer's waste, bean pods, etc. and turning them into precious milk by utilizing the cow is a great system. In order to improve their cow's reproductive

success, milk production, and Body Condition Score, the farmers should have the goal of feeding their cows more feed if possible.

Standardized, quality training should be provided for inseminators and herdsmen in Kampala, Uganda in order to reduce the possibility of error and establish a baseline for managing the cows. Most of the 10 farmers interviewed understood the beneficial and best practices for their dairy cows. However, the farmers usually lacked the capital or support to put those best practices into action. The government of Uganda does not provide any support to its smallholder farmers. It would make such a huge difference if the Ugandan government would provide an assistance or micro-loan program for the urban smallholder dairy farmers. If such a program existed, the farmers would have reduced risk for trying new practices and they would have the freedom to grow. A little support is all it would take to empower these farmers and help them reach new goals.

The combination of unskilled inseminators, bad timing, and inadequate nutrition contributed to the difficulty of AI in the Ugandan dairy cows. Improving available feed or inseminator competency could result in greater success with AI. At this point in time, it seems to be a much better idea to use natural service breeding with a bull if possible. If AI needs to be used, farmers should employ the use of synchronizing hormones to increase the success rate.

In the future, it would be interesting to do an economic study on these smallholder dairy producers in Kampala. An economic evaluation could determine if dairy production is actually profitable for the farmers and where they could improve their system. Overall, this research project evaluated the urban smallholder dairy system as a whole and provided insight into how different parts of the system interact with and influence each other. The farmers interviewed in

this study are champions of food and nutritional security for their families and for the entire city of Kampala.

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Tanga region of Tanzania. *Journal of the South African Veterinary Association.* 2005;76:224-227.

APPENDIX 1: RESEARCH SURVEY QUESTIONS

Section 1: Feed

- Type of feed:
- Quality of feed:
    - How long is the feed normally stored before it is fed to the cows?
    - How is the feed stored?
- How do the farmers get their feed and where is it coming from?
- Does the feed cost money and if so, how much?
- How much does each cow get to eat each day?
- Are the cows getting any supplements or vitamins/minerals?
- How many times are the cows fed per day? What times are the cows fed? Is that consistent?
- How are the cows fed? (Zero-grazing, communal herding, or tethering) Does the feeding system differ by season?
- Do the cows have constant access to water? Where is the water coming from?
- Does the farmer have a herdsman? If so, how much does he or she pay the herdsman per month?
- At what age are calves switched from milk to solid feed and how does that process work (is it a slow and gradual transition or fast)?

Section 2: Cows

- Number of cows:
- Breed of cows:
- Age of cows:
- Stage of cows (what was their calving date?):
- Body condition scoring for each cow (scored by Taylor and the weigh band):

- Feces scoring (done by Taylor):
- Overall health of the cows
    - Have you ever used/needed a vet?
    - If you use vaccines or antibiotics on your cows, do you know about and follow the milk withdrawal time period?
    - What is your main health issue with your cows?
    - Do you have problems with East Coast Fever or mastitis?
- How do you breed your cows?
- How many times do you serve/inseminate each cow usually? Is it successful on the first try?
- How do you detect heat in your cows?
- How old are your cows when you sell them? Do you sell them to another farmer or do you sell them for meat?
- How do you house (separate or together with mother) and feed (bucket or natural suckling) the calves? If they are housed with their mother, how long do they stay together before they are separated? What do you do with the bull calves?
- Are the cows treated any differently based on what milking stage they are in? For example, are they given different types or amount of feeds/supplements?
- At what point do you dry them off?

Section 3: Milk Output

- What is the average milk output for each cow per day in early lactation and late lactation?
- What is the milk fat level in the milk (take samples to analyze)?
- How many times per day do you milk the cows? What times do you milk the cows and are those times consistent each day?
- Do you use anything to clean the udder before or after milking?

Section 4: Milk End Use

- How do you use the milk?

- Do you keep any for your families consumption?
- If so, how much do you keep for consumption?
- How many people in your family drink the milk?
- Do you ever buy milk?
- How important is the milk to your family in terms of nutrition?
- Do you cook the milk before you drink it?
- Do you sell any of your milk?
- If so, to whom do you sell it to and how much do you sell it for?
- Where do you sell the milk from (your farm or a trading center)?
- Do you keep the milk refrigerated at all?
- What do you do with milk that does not sell?
- Will you sell milk that was gathered on a previous day?

Section 5: Miscellaneous

- What is the approximate land size of the farm? Is there enough room for each cow to lie down? How much of the land size is available to the cows? Calculate space per cow.
- What do you do with all of the cows manure?
- What are the major challenges you face as a smallholder dairy farmer?
- Do you keep records?
- How old are you and how long have you been keeping/managing dairy cows?
- Do you have any questions for me?
- Additional information

APPENDIX 2: Pictures

The View of Kampala

Conducting my Research with Dr Katongole and Interviewing Foster

Feed! Grasses and maize stovers

Banana Peels

Brewer's Waste in Storage

Betty, the First Farmer Interviewed

Pure Friesian Cow Eating out of an Old Bathtub